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Imperial Agricultural Conference.

Report by

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Report on the Effect of Different Dilutions of Latex and Strengths of Coagulant on the Plasticity, Vulcanising and Mechanical Properties of Rubber.

Report on the Effect on the Development of Mould of Hanging Rubber in the Factory after Smoking.

Report on Effect of Smoking Sheet with "Uncombusted" Smoke.

Standardisation of Methods of Testing.

Imperial Agricultural Conference.

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THE writer was privileged to attend the first Imperial Agricultural Conference held in London during October and November, 1927. The following short article does not purport to be a report of the proceedings of this Conference but merely a few notes on points raised during discussions and work actually seen in progress on certain of the Experiment Stations visited which would appear to have some bearing on the Plantation Rubber Industry.

The writer attended the meetings of the Soils Committee and by so doing missed meetings of Committees on Plant Pathology and Plant Breeding, but it was thought that the former would prove more productive of information likely to be of value to Rubber Growers in Ceylon. A large part of this paper therefore will deal with soils and the discussions held on that subject.

During the itinerary arranged for delegates by the Empire Marketing Board the stations of Rothamsted and East Malling among many others were visited and these visits will be mentioned in connection with points of interest which arose. Although not a member of the Committee which discussed Agricultural Economics the writer collected a certain amount of information on the subject which may be of value to estates especially during periods of depression where strictly economical working is essential.

Soils and Fertilizers.—The subject matter of the discussions was as follows:—

(1) Functions of a Soil Bureau.

(2) Soil surveys; unification of methods,—Laterite soils.

(3) Fertilizer trials; possibility of obtaining some degree of uniformity in the principles underlying.

(4) Shifting Cultivation; the means of avoiding it and the means of maintaining fertility. This item to include Soil Deterioration, Green manuring, Use of Artificial Fertilizers and the Utilisation of waste Cellulosic Materials.

It is unnecessary to enlarge on the importance of the study of soils especially in Ceylon where in many districts the same soils have borne in turn crops such as Coffee, Tea and Rubber. It is now I think realized that many serious mistakes in soil management have been made in the past, witness the washed out condition and lack of organic content of the soil in most of the rubber planting districts; and the belated rush to grow cover crops. The study of soils is still really in its infancy although the past decade has witnessed very great changes in our conception of soils.

Work is now being carried out in every country with an Agricultural industry and what is most needed now is co-operation amongst those workers so that progress may not be impeded by unnecessary repetition of work or lack of knowledge of suitable methods of procedure. The general opinion of the Soils Committee at the Imperial Agricultural Conference was that the first need was the establishment of a centre for the distribution of information. This was considered to be one of the chief functions of any Bureau established. Isolated workers have not always facilities for examining work previously done elsewhere on problems closely resembling those which they have in hand, also, methods are being continually improved and changed and results are much more easily compared and of much more value when the same method of investigation has been adopted. A Soil Bureau therefore should have as complete a library as possible on soil science and should collaborate with all soil workers in the Empire to keep it complete and should be able to render assistance. By some such system methods would gradually become standardised and the results obtained more easily compared *inter se*. The establishment of such an Information Centre would of course mean the collection of a competent staff. The above was considered to be the branch of the work which should have immediate attention.

Among other lines of work which were set down was the organization of soil surveys in the Empire, and here help was to be given to individual workers or institutions by (a) the working out of methods for use in field and laboratory, (b) identification of soil minerals and furnishing of complete mineralogical and chemical analyses, (c) the development of new work and assistance in co-ordination of existing surveys, (d) formation of a collection of the principal soil types of the Empire; publication of results. Also the Bureau should be available for the supply of advice and assistance in the organization of experimental work

on the maintenance and increase of soil fertility by cultivation, fertilizers, irrigation and other means, and the arrangement of visits from its specialist officers to the colonies and general interchange of workers. The organization of Specialist Conferences would also come within the scope of such a Bureau.

It was decided that Rothamsted would be the best location for the Bureau as its functions could only be carried out in close association with an institute dealing with soil problems. There is also a comprehensive library there and a staff of experts already engaged on the various aspects of soil study.

The Committee dealt with the other subjects enumerated above and it was decided that recognized leading workers should present memoranda on the following subjects to the Bureau to enable standardisation of methods to be effected and suggestions for experimental work to be made.

(1) Soil classification.

(2) Methods of Mechanical Analysis of soils.

Here the following resolution was passed.

" It is desirable that, where soil survey data are to be published the mechanical analysis should be made by the International method or by some other method which has been shown to give the same results, it being recognized that certain soil types such as laterites and highly calcareous soils require special methods."

(3) Fertilizer Trials.

(4) Soil Deterioration; resulting from shifting cultivation. Deafforestation, etc.

In connection with Fertilizer trials discussion showed that differences in crops and conditions made it impossible to lay down any detailed scheme which would be applicable over all. As a basis of discussion the Rules drawn up by the International Commission for the study of chemical Fertilizers were used and as these may prove interesting they are given below:—

(1) **Soil.**—Choose a soil as uniform as possible, and test it by a sufficient number of borings, arable layer down to.....cm. sub-soil..... Avoid ground with a steep slope, especially in not very permeable soil. If sloping ground has to be used, mark out rectangular plots elongated at right angles to the run of the valley.

(2) **Shape of the plots.**—Be guided by the possibilities of the ground and other local conditions for marking out square or rectangular plots.

(3) **Area of the plots.**—Give each plot a minimum area of 25 sq.m. and a maximum of 100 sq.m.

(4) **Number of plots.**—Repeat the same test at least 5 times and have at least 5 control plots.

(5) **Distribution of the plots.**—Distribute them uniformly according to the dimensions and lie of the ground.

(6) **Paths between the plots.**—The plots should be contiguous except for leaving a path in a single direction 50 cm. wide between every second plot to facilitate cultural operations and inspection, seeding to cover uniformly the whole surface of the plot. For the harvest, plants to a width of 50 cm. inside the boundaries of each plot are first of all removed. The experiments are therefore always separated from each other by a distance of 1 metre on 3 sides and by 1 m. 50 on the side of the patch.

(6a) **Distribution of the fertilizers.**—The fertilizers should be applied accurately and regularly, special attention being given to the application of farm-yard manure. Each fertilizer should be applied at the most suitable time to have good effect, in one or several applications.

(7) **Duration of the tests.**—Continue the testing of the same areas during at least 5 years on successive crops.

(8) **Characteristics of the soil and climate.**—Note them and publish them with the results:—*Soil*, locality, depth, analysis (methods of the International Association of Soil Science, and for dry climates repeated determinations of the humidity of the soil). *Climate*, temperature, nebulosity, rainfall—quantity and number of days,—snow—actinometry.

(8a) **Composition of the fertilizers.**—Always give precise indications of the fertilizers used:—Nature, origin, fineness, complete chemical analysis and finally petrographic or microbiological characters.

(9) **Plants used.**—Always use well-tested seeds, indicate their quality the density of sowing. State very precisely the variety and origin.

(10) **Remarks on growth.**—Note the essential facts of growth, their dates, attacks of diseases or of parasites. Weeds, Treatment applied. Casualties or damage caused by meteorological factors or fortuitous.

(11) **Crop.**—It is recommended that the results should always be expressed in air-dried matter and in dry substance.

(11a) **Experimental error.**—The experiment will be considered as demonstrative when the differences of the average results obtained are less than double the probable error.

(11b) **Experimental Farms.**—The commission considered it advisable to establish an experimental farm in each natural region subject to the direct control of laboratories of the different departments co-operating in the improvement of agriculture.

As already suggested only the basic rules are applicable to all crops. With rubber rule 1 is applicable. Rule 2 is also to a certain extent applicable but here, if accurate results are to be obtained, it will be necessary to arrange the plots so that the personal factor of the skill of the tapper can be eliminated. No. 3 does not apply; No. 4 does. Rules 5, 6a, 7, 8, 8a, 10, 11, 11a, apply generally. Rule 6 obviously does not apply with a tree crop. Rule 9 will not apply as a general rule as manuring trials are usually carried out on blocks of old rubber, the object being to see whether these can be improved and made more productive. This rule would apply if botanically uniform material were used for planting up and manuring started immediately after planting.

At Rothamsted the work actually in progress at the time was seen. This was all intimately concerned with soils.

In the Bacteriology Department work was being conducted on the inoculation of Lucerne seed with cultures of the nodule organism, Bacillus radicicola. Besides the laboratory and greenhouse work, field trials at 50 centres were in progress. The life history of the organism and the relation of the plant to the formation of nodules are being studied as well as the changes from day to day in the number of bacteria present in field soil. The Botany Department has in hand the study of the actions of various chemicals such as copper sulphate and silicates upon plant growth, and an investigation into the physiological significance of boron in the nutrition of plants. Here also a study of the controlling of weeds is being made and manuring trials on meadow hay are in progress.

It is impossible in a paper of this nature to give any real indication of the number of investigations in hand in the Chemistry Department, and a list of the subjects under study only will be given.

Soils and Fertilizers.

(a) Nitrogen and Carbon Cycles.
(b) Green manuring.
(c) Chemical processes in the Soil.
(d) Soil reaction.
(e) Phosphatic fertilizers.
(f) Superphosphate.
(g) Nitrogenous fertilizers.
(h) Potassic fertilizers.

Crops.

(a) Barley investigations.
(b) Sugar beet.

Fermentation Department.—The work here is concerned with the converting of straw and other cellulosic materials into Synthetic Farmyard Manures, and especially the action of fungi, as distinct from bacteria, in the breaking down of cellulosic matter.

Another branch of the work is the study of methods of purification of the effluents from Beet Sugar Factories which are polluting the rivers. In the *General Microbiology Department* the following are the subjects under investigation.

(a) Reproductive rates of various Protozoa in the soil.
(b) The conditions which cause the Cystic physiological condition in Protozoa.
(c) Study of life histories and physiology of protozoa.
(d) Effect of sterilisation of soil.
(e) Effect of pure cultures of protozoa and bacteria, on nitrogen fixation, ammonification and carbohydrate decomposition in various soils and under different conditions.

Insecticide and Fungicide Department.

(1) Study of insecticidal action of plant extracts in all its aspects.
(2) Study of the changes which sulphur undergoes in the soil. This has arisen from the very variable effect of finely divided sulphur thoroughly mixed with the soil on the wart disease organism.

Soil Physics Department.—The properties of the soil that are studied in this department can be broadly divided into two groups dealing respectively with the soil particles themselves, and their relations to the soil water. The first group embraces problems of soil tilth, the effect of clay and organic matter, and the colloidal properties of the soil.

The second group includes studies of the complex relations between the soil-solution and the soil, especially those that bear on problems of soil acidity.

Considerable work is being done on soil cultivation, and in particular on the resistance offered by a soil to the passage of a plough, and laboratory methods have been devised to study the soil properties concerned. Dynamometer records of drawbar pull obtained in the field are in effect the integration of these soil properties, and form a sensitive measure of the variation of soil characteristics. The results show a large degree of significant variation even on areas apparently uniform to visual inspection. The drawbar pull is closely correlated with soil properties such as drainage and also with plant growth. The latter aspect is being closely followed up in view of its importance in modern experimental plot technique.

The meteorological section of the department has been considerably extended by the installation of self-recording devices. Work in progress includes a study of soil temperature fluctuations, and the relation between rainfall and drainage.

Statistical Department.—Two meteorological enquiries are in progress, both extensions of the previous work in which the effects of rainfall at all seasons of the year upon the wheat crop, were calculated. A parallel study is now being made upon the responses of barley under different manurial treatments to rain; the importance of temperature records, especially in relation to horticultural crops, has led to a comprehensive statistical study of the Rothamsted records.

In view of the intimate relations between weather responses and manurial treatment (and also between weather response and variety), efforts have been made to improve the design of field plot experiments up to a level of accuracy at which they will begin to throw light on these problems. Such improvement is for all purposes a standing need. It is now possible to lay down definite rules under which results of known accuracy may be obtained from admittedly heterogenous soil; and it has been shown from the study of uniformity trials, that in such systems of experimentation, the errors may be reduced, if necessary, within one per cent.

Institute of Plant Pathology.

Entomology Department.

(1) A study of the chief factors governing the reproduction and migration of Aphides with special reference to the Bean Aphis and the Hop-Damson Aphis.

(2) Rearing and investigation of parasites with special reference to their influence in controlling injurious insects.

(3) Apicultural investigations. A study of some immediate practical problems of apiculture, and of the changes in temperature, moisture, and carbon dioxide inside the hive.

(4) The biological control of certain noxious weeds by means of their insect enemies (in conjunction with the Cawthron Institute, New Zealand).

(5) Gall-midges affecting cereals and the seeding of meadow foxtail.

Mycology Department.—The investigations in progress include:—

(1) The soil fungi and algae; their kinds, numbers, distribution and activities in the soil.

(2) The genetics of fungi; morphological and physiological strains and the scope and nature of genetic and other changes of fungi in culture and on the living plant; the relation of such changes to disease.
(3) The relation of nutrition to parasitic disease in plants.
(4) The physiology of parasitism with special reference to fungal and bacterial diseases of tropical crops.
(5) The physiology and genetics of the Smut fungi with particular reference to diseases of cereal crops.
(6) The nature and causes of Virus diseases of plants.
(7) Wart disease of potatos; (a) the nature of immunity; (b) method of testing immunity or susceptibility.
(8) Fungicidal investigations; substances toxic to Synchytrium endobioticum.

Field Experiments.—The variations in yield of field crops due to manurial, seasonal and soil factors are studied by quantitative plot observations on the growth of the crop throughout the season. In the laboratory the analysis is carried further and detailed measurements are made on samples chosen from the field plots.

These measurements furnish data for the investigation of such fundamental physiological processes as rates of growth, net assimilation, uptake of nutrients and maturation of the grain.

The above is partly copied from a leaflet issued to delegates of the Conference and shows the very varied nature of soil studies. That Rothamsted is the most suitable situation for the proposed Bureau of soils cannot well be doubted.

East Malling Research Station.

The work here is not so intimately concerned with soil study although the latter can never be quite absent during Agricultural research. The subjects under investigation here which are of special interest and significance to Rubber growers are as follows:—

(a) Budding and grafting.
(b) Variation in stocks.
(c) Methods of overcoming this; vegetative propagation.
(d) Effect of stock on scion.
(e) Field recording.

On (a) I need not comment; we have a satisfactory method of budding. The variation in material, particularly stocks, in fruit growing is however a very important matter where large clones of a permanent crop are being raised. Seedling stocks have been proved to be very variable while vegetatively raised

stocks are more or less uniform. The variation between individuals in two clones of apples where vegetatively raised stocks were used was exactly half that found on seedling stocks. It has also been found that a large measure of control over the tree obtainable can be exercised by judicious choice of rootstocks. Rootstocks affect:—(a) Size of tree, (b) Rate of growth, (c) Early or late fruiting in fruit trees.

There seems no reason to assume that similar if not so great effects may not be brought about by the use of different varieties of stock in Rubber budding. There is a large difference between individuals in any of the present clones of budded rubber although this is certainly smaller than that found in a plantation of mixed seedlings. It seems very probable that this can be reduced still further by the raising of stocks vegetatively. Much work will however have to be done to find out which stocks are going to give rapidly maturing trees of high yield. A study of the mutual effect of stock and scion is essential before uniform blocks of high yielding trees can be obtained.

In certain cases at East Malling incompatibility of stock and scion has been found. Growth, although at first vigorous on certain stocks, later practically ceases and a weak union is obtained. This was found with Pears on certain quince stocks. A point of interest which may be mentioned here was the beneficial effect of potash manure as a preventive of "Leaf scorch." Potash is known to thicken the cuticle on leaves and is beneficial against certain leaf diseases of rubber.

Field Recording.—Records are made of the following for each tree.

1. Its height and spread.
2. Girth of the stem.
3. Length of new wood grown since previous season.
4. Number of fruits produced and the weight and perhaps colour.
5. Any particular manifestation such as prevalence of mildew; leaf scorch, scab, etc.

and occasionally

6. Fruit buds are counted.
7. Where pruning employed. Weight of prunings removed.
8. Occasional tree lifted, weighed and a thorough examination of root system made.

Some such thorough method of recording will be essential in connection with similar work undertaken with rubber.

Agricultural Economics.—This to many will appear to be a new science, and it is true that its real importance has been realised only during the past decade. The principal Colleges of Agriculture are now paying particular attention to this aspect

of the agricultural question. Until quite recently practically no farmers in Great Britain kept any books to show the state of their affairs and the result was that it was impossible for them to compare the value of their various crops as paying propositions. They could not tell what the cost of cultivation of a certain field had been and had no means of estimating the net return on outlay of their various fields.

The Economics Sections at Oxford and Cambridge are now carrying out detailed work of this nature on farms of various types, and already benefits have been derived. Farmers are enabled to say which is their best-paying crop and can reduce or omit from their rotation any which is grown at a loss on their particular farm.

This may seem rather remote from rubber growing but it is thought that a little consideration will show the connection. Here one crop only is grown and from earliest times estates have had to record all transactions in a business-like manner. In this way estates are ahead of the majority of home farmers, they can tell the actual cost of their various operations, Tapping, Weeding, Agricultural works, Disease work, Manufacture, etc., and can give accurate figures as to how the total cost of production of the pound of dry rubber is distributed amongst these various works. On different estates cost of production varies within wide limits, and this is not completely due to variation in yield between these estates. Very often one finds that a planter takes more interest in one of the many estate works than in the others. This he reduces to a fine art and takes pride in the fact that his cost of tapping or whatever it may be is lower per pound of dry rubber than that of any other estate around. This is all worthy of encouragement but it benefits only the one work on the one estate. Were someone to spend say six months going round rubber estates and examining costs of all the various works it is thought that some interesting and useful figures would be obtained. One estate would it is expected tap efficiently at a cheaper rate than any other, another would manufacture cheaper and so on. Further study and enquiry might quite possibly elucidate the reason for cheapness of these operations, probably it might be run down to more efficient organization in one case or more efficient machinery in the factory, in another special attention to minor details, or elimination of all sources of loss of crop, etc. Information of this description available to large firms would enable them to profit by ensuring that all works on all their estates were carried out in the most economical manner.

Much more might be said on the subject but it is thought the above is sufficient to indicate the desirability of holding an enquiry especially at the present time into the great variation seen in costs of production.

Report on the Effect of Different Dilutions of Latex and Strengths of Coagulant on the Plasticity, Vulcanising and Mechanical Properties of Rubber.

THE effect on the quality of rubber of coagulating latex with different amounts of acetic acid has been investigated on several occasions and the conclusion has been reached that the amount of acid used may be increased considerably beyond the minimum required for complete coagulation without adversely affecting the vulcanising and mechanical properties of the rubber. The reason for this is that acetic acid is a weak acid. If however an excess of a stronger acid (such as formic or sulphuric) is employed it is found that the rubber vulcanises more slowly than when the minimum amount is used, and in extreme cases the mechanical properties are adversely affected (see Investigations of the Ceylon Rubber Research Scheme.—Quality of Plantation Rubber, p. 164). As formic acid has now largely replaced acetic acid and as some estates use sodium silicofluoride as a coagulant, the London Advisory Committee considered it of importance to determine the effect of different amounts of these coagulants with different dilutions of latex not only on the vulcanising and mechanical properties but also on the plasticity of the raw rubber. The matter was discussed with Mr. O'Brien while he was in England on leave and he undertook to prepare samples for investigation.

Description.

Two sets of crepe were prepared from latex containing 15 and 30 per cent. dry rubber, using different amounts of acetic and formic acids and sodium silicofluoride. The latter being a relatively weak coagulant will not completely coagulate latex of 30% concentration. No samples were therefore prepared from 30 per cent. latex using sodium silicofluoride as a coagulant. Otherwise 1, 2, 4 and 6 times the minimum amount of each coagulant was used for both dilutions of latex, the minimum amounts being taken as:—

	15 per cent. latex.	**30 per cent. latex.**
Acetic acid	1:180 parts dry rubber.	1:250 parts dry rubber.
Formic acid	1:360 parts dry rubber.	1:500 parts dry rubber.
Sodium silicofluoride	1:200 parts dry rubber.	—

When acetic and formic acids were used 1 part of sodium bisulphite per 250 parts of rubber was added to the 30 per cent. latex and 1 part per 180 parts to the 15 per cent. latex.

The latex was obtained from the same group of trees on Culloden Old Division, the samples from 15 per cent. latex being prepared two days later than those from 30 per cent. latex. The morning following the addition of coagulant the samples were rolled to thin crepe by the usual procedure, i.e., five times through the grooved rollers and once through the smooth roller.

When four or six times the normal amount of acetic and formic acids was used, coagulation was very rapid and the latex thickened considerably before it was distributed to the coagulating dishes. Mr. O'Brien observes that in practice it is certain that these excessive amounts of acid would never be used except by mistake, owing to the inconvenience caused.

Results of Examination.

The samples were submitted to plasticity and vulcanisation tests at the Imperial Institute six months after preparation.

Plasticity Tests.

The following table summarises the results obtained in these tests:—

Sample No.	Dilution of latex (per cent)	Coagulant Nature	Quantity used	Time of Mastication (mins)	Raw Rubber D30 mm./100	Masticated Rubber D30 mms./100	Masticated Rubber Ev ccs.
1286	30	Acetic	Normal	24½	166	76	14·1
1287	,,	,,	2 x do.	23½	164	76	14·9
1288	,,	,,	4 x do.	23	163	73	14·2
1289	,,	,,	6 x do.	23½	159	79	14·9
1290	,,	Formic	Normal	23	172	77	11·9
1291	,,	,,	2 x do.	24½	166	76	13·1
1292	,,	,,	4 x do.	23½	163	76	14·2
1293	,,	,,	6 x do.	24	158	72	16·0
1294	15	Acetic	Normal	22½	153	72	11·5
1295	,,	,,	2 x do.	23	157	75	10·9
1296	,,	,,	4 x do.	23	152	78	11·0
1297	,,	,,	6 x do.	22½	159	78	9·9
1298	,,	Formic	Normal	22	157	76	11·1
1299	,,	,,	2 x do.	22	161	77	9·3
1300	,,	,,	4 x do.	22	151	73	10·7
1301	,,	,,	6 x do.	23½	145	70	11·0
1302	,,	Sodium silico fluoride	Normal	25	159	75	12·8
1303	,,		2 x do.	23½	166	73	11·3
1304	,,		4 x do.	23	163	73	14·8
1305	,,	,,	6 x do.	23½	154	74	14·3

The plasticity of the raw rubbers as indicated by the D30 values is fairly constant but the results of the tests on the samples from 30 per cent. latex indicate that increasing in strength of the coagulant increases the plasticity of the raw rubber. This however is not confirmed by the tests on the samples from 15 per cent. latex.

The samples were masticated until a fixed amount of power had been consumed. Under these conditions the time of mastication did not vary greatly.

In the case of the masticated rubber, only the formic acid samples from 30 per cent. latex give definite indications of the plasticity of the rubber increasing with the strength of the coagulant.

The plasticity of the rubber produced by the different coagulants from the same latex shows some variation, but the differences are small and irregular.

The conclusion is drawn from these experiments that the plasticity of air-dried crepe (six months old) is not greatly affected by the nature or amount of the coagulant when acetic or formic acid or sodium silicofluoride is employed with normal dilutions of latex.

Vulcanisation Tests.

(a) **Rubber-sulphur mixing.**—The following are the results of vulcanisation tests in the rubber-sulphur mixing (90·10), all the samples being vulcanised for 100 minutes at 148°C.

Sample No.	Dilution of latex (per cent.)	Coagulant Nature Quantity used	Tensile Strength (lbs./sq. in.)	Elongation at load of 1·04 kgs./sq. mm. (per cent.)	Calculated time of vulcansation (mins.)
1286	30	Acetic Normal	1480	907	133
1287	,,	,, 2 x do.	1620	933	140
1288	,,	,, 4 x do.	1660	903	132
1289	,,	,, 6 x do.	1540	925	138
1290	,,	Formic Normal	1950	900	131
1291	,,	,, 2 x do.	1440	926	138
1292	,,	,, 4 x do.	1780	915	135
1293	,,	,, 6 x do.	1770	904	132
1294	15	Acetic Normal	1350	980	151
1295	,,	,, 2 x do.	1480	990	154
1296	,,	,, 4 x do.	1390	972	149
1297	,,	,, 6 x do.	1370	980	151
1298	,,	Formic Normal	1450	960	146
1299	,,	,, 2 x do.	1300	960	146
1300	,,	,, 4 x do.	1630	935	140
1301	,,	,, 6 x do.	1850	910	134
1302	,,	Sodium Normal	1490	975	150
1303	,,	silico 2 x do.	1560	964	144
1304	,,	fluoride 4 x do.	1750	950	147
1305	,,	,, 6 x do.	1380	974	150

The results show that the rubber prepared from the 15 per cent. latex vulcanised more slowly than rubber from the 30 per cent. latex. No conclusions can be drawn from this as the 15 per cent. latex was not obtained by diluting the 30 per cent. latex but by the dilution of another quantity of latex obtained from the same trees two days later. There is no indication that the amounts of the coagulants used have a marked effect on rate of vulcanisation. This is contrary to previous experience with sheet rubber and may be due to the more thorough removal of coagulant in the preparation of thin crepe.

(b) **Zinc-Ozide-Accelerator Mixing.**—The samples were also tested in the mixing 100 rubber, 6 zinc oxide, 2·75 sulphur and 0·4 diphenylguanidine. This mixing has been substituted for the previous accelerator mixing employed in routine tests at the Imperial Institute as the results obtained with it exhibit much wider variation, the cause of which is now under investigation. The results of tests are shown in the following table:—

Period of Vulcanisation at 148°C.

Sample No.	Dilution of latex (per cent)	Coagulant Nature Quantity	40 mins.		60 mins.		75 mins.	
			Tensile Strength (lbs./sq. in.)	Elongation at load of 1·04 kgs./sq. mm. (per ct.)	Tensile Strength (lbs./sq. in.)	Elongation at load of 1·04 kgs./sq. mm. (per ct.)	Tensile Strength (lbs./sq. in.)	Elongation at load of 1·04 kgs./sq. mm. (per ct.)
1286	30	Acetic Normal	1790	810	1750	815	1890	795
1287	,,	,, 2 x do.	1990	810	2070	810	1620	802
1288	,,	,, 4 x do.	1980	800	1900	807	1910	799
1289	,,	,, 6 x do.	1940	800	1970	796	2060	806
1290	,,	Formic Normal	1830	817	1870	804	1910	799
1291	,,	,, 2 x do.	1850	817	1740	801	1920	815
1292	,,	,, 4 x do.	1720	805	1830	795	1850	812
1293	,,	,, 6 x do.	1830	805	1730	814	1830	815
1294	15	Acetic Normal	1830	795	1850	826	1880	808
1295	,,	,, 2 x do.	1980	793	1790	806	1780	810
1296	,,	,, 4 x do.	1760	815	2060	809	1980	806
1297	,,	,, 6 x do.	2120	812	2010	802	1990	799
1298	,,	Formic Normal	1910	814	1930	814	2120	804
1299	,,	,, 2 x do.	2060	799	2070	807	2100	790
1300	,,	,, 4 x do.	1980	820	2180	809	1900	805
1301	,,	,, 6 x do.	2010	815	2030	810	2060	806
1302	,,	Sodium Normal	1770	820	1870	824	1830	828
1303	,,	silico 2 x do.	1650	833	1770	817	1710	814
1304	,,	fluoride 4 x do.	1640	847	1890	830	1800	830
1305	,,	,, 6 x do	1910	816	1920	826	1870	822

The samples have given fairly uniform results, the differences being much less than those previously observed in the case of rubber recently examined from different estates.

Conclusions.

The results indicate that in the case of thin crepe the use of different amounts of acetic or formic acid or of sodium silicofluoride is not a cause of variation in plasticity or in vulcanising and mechanical properties. With this type of rubber therefore the substitution of formic acid or sodium silicofluoride for acetic acid on estates is not likely to give rise to greater variations in the properties of the rubber, owing to diverse practices on the accidental use of excessive amounts of coagulant than has occurred with acetic acid.

Imperial Institute, London,
19th March, 1928.

Report on the Effect on the Development of Mould of Hanging Rubber in the Factory after Smoking.

Previous small scale experiments by Mr. O'Brien indicated that smoked sheet is more liable to develop mould if allowed to hang in the factory before packing.

Further trials have now been carried out on a larger scale with estate rubber which was packed during the showery weather following the S.W. monsoon and forwarded to London for examination on arrival.

The samples consisted of smoked sheet, one portion of which was packed in a wooden chest soon after removal from the smoke house and the remainder after hanging in the packing room for 14 days. Rubber lining sheets were placed round the samples in each case.

The experiment was repeated two days later, the only modification being that a portion of the rubber was hung in the packing room for 15 instead of 14 days.

The chests containing the rubber packed soon after smoking were opened in Ceylon after a fortnight and samples removed as quickly as possible for comparative tests with the rubber hung in the packing room. These tests showed that the samples hung in the packing room had absorbed moisture and in addition had become more liable to develop mould.

. On arrival in London the rubber was inspected by a member of the staff and it was found that the sample which had been hung for 15 days in the packing room was mouldy. The corresponding sample hung for 14 days and the two samples packed soon after smoking had not developed mould.

In accordance with Mr. O'Brien's request samples were removed from the centre of each chest, transferred to stoppered bottles, inocculated subsequently with a pure culture of Oospora sp., and kept at 29°C over a 7 per cent. salt solution. After 14

days a comparison was made of the amount of mould on the four samples with the following results:—

Experiment	When Packed	Percentage of Moisture on Arrival	Estimated Percentage of Sample Covered with Mould after 14 days test.
First	Packed 1 hour after smoking ...	0·30	10
Second	Packed 1 hour after smoking ...	0·40	10
First	Hung 14 days after smoking ...	0·33	20
Second	Hung 15 days after smoking ...	0·25	60

It will be seen that the samples of rubber which had been hung in the packing room developed much more mould than those packed soon after smoking. The duplicate samples which were hung in the packing room showed considerable difference in the extent of mould development; the sample giving the highest results was the one which had become mouldy during transit to London.

These results confirm Mr. O'Brien's conclusions that smoked sheet packed directly after smoking is less liable to develop mould than when allowed to hang for some time in the packing room.

Imperial Institute, London,
19th March, 1928.

Report on Effect of Smoking Sheet with "Uncombusted" Smoke.

Small scale experiments by Mr. O'Brien have shown that sheet dried in " uncombusted " smoke requires less firewood and is less liable to develop mould than sheet dried in "combusted" smoke. "Combusted" smoke is derived from fuel burnt with a larger supply of air than in the case of "uncombusted" smoke.

The following report deals with the results of the investigation of samples prepared in connection with further experiments carried out by Mr. O'Brien on a larger scale, the old Rubber Growers' Association laboratory being used for smoking with "uncombusted" smoke. The smoke was produced from rubber wood burning in a 5 gallon oil drum fitted with a perforated lid. The temperature was maintained between 110°F and 115°F by means of charcoal braziers.

Latex was obtained from the Culloden S. Division factory and sheet prepared by the estate method, which is very similar to that suggested by the Rubber Growers' Association. Six sheets were smoked in the S. Division smoke house continuously for 14 days, and an equal number in the experimental smoke chamber for 16 days of 10 hours a day.

Mr. O'Brien reported that the sheets from the experimental smoke chamber were darker than those from the estate smoke house, and slightly more shiny—a defect usually associated with rapid smoking. On arrival at the Imperial Institute there was only a slight difference in the appearance of the samples, this difference being similar in character to that described by Mr. O'Brien.

Tests conducted by Mr. O'Brien on the liability to mould showed that the rubber from the experimental smoke chamber was more resistant to mould growth than that smoked on the estate.

The following are the results of plasticity and vulcanisation tests at the Imperial Institute:—

1. Plasticity.

Sample No.	Type of smoke	Raw Rubber.		Masticated Rubber	
		D 30	Time of mastication	D30	Ev.
		(mm./100)	(mins.)	(mm./100)	(ccs.)
1311	"Combusted smoke" ...	145	22½	77	10·8
1312	"Uncombusted smoke" ...	157	23	76	12·8

2. Vulcanisation tests.

Sample No.	Type of smoke.	Tensile Strength	Elongation		Calculated time of vulcanisation.
			At Break.	At load of 1·04 kgs./sq.mm.	
		(lbs./sq. in.)	(mins.)	(per cent)	(mins.)
1311	"Combusted smoke" ...	1530	959	936	140
1312	"Uncombusted smoke" ...	1240	957	975	150

There is no important difference in the results. As in the case of a similar smoking experiment carried out previously on a smaller scale the sample smoked with "uncombusted" smoke is a little more plastic after mastication than that smoked with combusted smoke.

The present samples vulcanise slowly, that smoked with "uncombusted" smoke being exceptionally slow curing. The tensile strengths are satisfactory for the state of cure, but are slightly below the average.

Imperial Institute, London, S.W. 7.
15th February, 1928.

Standardisation of Methods of Testing.

The question of methods of testing raw rubber was discussed at a conference held on 13th October, 1927, between Dr. de Vries of the Central Rubber Station and representatives of the London Committee of the Ceylon Rubber Research Scheme, and it was agreed that standardisation is desirable.

The methods employed by the planters' research organisations for vulcanisation tests have all developed along similar lines differing only in detail. In view of the fact that sufficient data has been collected it seems desirable that uniform methods should be employed as even small differences in procedure complicate comparison between the results obtained in different laboratories.

It is considered that as far as the planters' research organisations are concerned standardisation is feasible and, it is suggested, that if a method of testing is agreed upon by these organisations it should be submitted to the Rubber Division of the American Chemical Society, the Netherland Research Institute at Delft and the Research Association of British Rubber and Tyre Manufacturers.

In order that the laboratories concerned may have the fullest opportunity of studying these questions it is suggested that the Rubber Research Institute, Malaya, should be informed of the duplicate tests in progress in Java and at the Imperial Institute, and invited to participate in further work.

The methods now generally employed in the three laboratories together with those used in the duplicate tests are shown in the following table:—

Testing Station	Parts sulphur per 100 of rubber	Temperature of vulcanisation	Standard of Vulcanisation
*Department of Agriculture, Malaya	11·1 (90·10)	140°C	Standard curve.
Central Rubber Station, Java	8·1 (92·5·7·5)	151°C	Elongation 890% at load of 1·30 kgs./sq. mm.
Imperial Institute, London	11·1 (90·10)	148°C	Elongation 775% at load of 1·04 kgs./sq. mm.
Duplicate tests in Java and at the Imperial Institute	100·10	148°C-151°C	None at present but the usual load and elongation figures are determined from stress-strain curves.

* No information is available concerning the methods to be adopted by the Rubber Research Institute, Malaya.

Observations on Method used for Duplicate Experiments.

Mixing.—The 100·10 rubber-sulphur mixing has the approval of the Rubber Division of the American Chemical Society and it is useful to express the proportion of any compounding ingredients in terms of 100 parts of rubber.

In laboratories where a large number of samples has to be tested it is necessary that vulcanisation should be carried out expeditiously and a temperature near 150°C would be the most suitable for this purpose.

Standard of vulcanisation.—Both the Central Rubber Station, Java, and the Ceylon Rubber Research Scheme (Imperial Institute) vulcanise to a fixed elongation at a definite load. This has the advantage of being more clearly defined than the standard curve. It should not be difficult to agree upon a suitable standard of vulcanisation when the 100·00 mixing has been more fully studied.

Plasticity tests.—It is desirable that steps should be taken to avoid the independent development of plasticity tests on different lines by the various research organisations and for this purpose it would be of considerable advantage if a scheme could be agreed on for the investigation of methods of testing.

Imperial Institute, London,
January 27th, 1928.

NOTICES.

SUBSCRIPTIONS.

Arrangements have now been made for Bulletins of the Ceylon Rubber Research Scheme to be made available to non-contributors to the Scheme at the rate of Rs. 15-00 per annum, post free.

OFF-COLOURED CREPE.

The Chemist to the Rubber Research Scheme would be glad to get into touch with the Superintendent of any estate who is troubled with off-colour crepe, and who thinks that this may be due to impurities in the water used for manufacture.

GLASS METROLOCS.

Glass Hydrometers for testing latex as specified and as recommended by the Rubber Research Scheme (Ceylon) may be obtained at a cost of Rs. 12-50 each from :—

Messrs. WALKER, SONS & Co., Ltd.,
Engineering & Estate Supplies Department,
Colombo.